

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

## FINAL EXAMINATION

TRIMESTER 1, 2018/2019

**PGC0225 – GENERAL CHEMISTRY**  
(Foundation in Life Sciences students only)

13 October 2018  
2.30 p.m – 4.30 p.m

(2 Hours)

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### INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages only excluding the cover page.
2. Answer **ALL** questions.
3. Please write all your answers in the answer booklet provided.
4. Distribution of marks for each question is given.
5. Calculator is permitted.

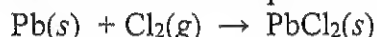
**Instructions:** Answer ALL questions.

**Question 1 [10 marks]**

- a. Protein X contains 0.33% by mass of iron. Each molecule of X has two iron atoms. Calculate the relative molecular mass of X. [Atomic mass : Fe = 55.8]

[2 marks]

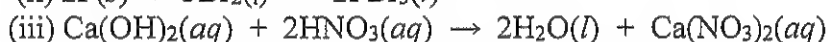
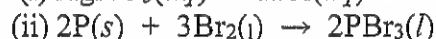
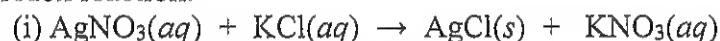
- b. Lead reacts with chlorine to produce lead(II) chloride.



In an experiment, 177.5 g of chlorine produces 350.0 g of lead(II) chloride. What is the percentage yield of the experiment? [Atomic mass : Cl = 35.5; Pb = 207.0]

[2 marks]

- c. Classify each of the following processes as a precipitation, acid-base neutralization, or redox reaction. [3 × ½ mark]



- d. How might you use a precipitation reaction to prepare a sample of  $\text{Ca}_3(\text{PO}_4)_2$ ? Write the molecular equation. [1 mark]

- e. Assuming that Coca Cola has the same specific heat as water [4.18J/(g · °C)], calculate the amount of heat (in kJ) transferred when one can (about 350 g) is cooled from 25°C to 3°C. [1½ mark]

- f. How much heat (in kJ) is evolved when 5.0 g of aluminium reacts with a stoichiometric amount of  $\text{Fe}_2\text{O}_3$ ? [Atomic mass : Al = 27.0]



[2 marks]

**Question 2 [10 marks]**

- a. Green light has a frequency of  $5.75 \times 10^{14} \text{ s}^{-1}$ . Calculate its wavelength (in nm).

[C =  $3.00 \times 10^8 \text{ m/s}$ ]

[1 mark]

- b. Determine the maximum number of orbitals in,

[2 × 1 mark]

(i) the third principal shell

(ii) the first three principal shells of an atom

- c. Why the following combinations of quantum numbers are not allowed? Explain.

[2 × ½ mark]

(i)  $n = 3, l = 0, m_l = -1$

(ii)  $n = 4, l = 4, m_l = 0$

Continued.....

- d. Given the subshell 1s, 2s, 2p, 3s, 3p, and 3d. Identify those that meet the following descriptions: [6 × ½ mark]
- (i) Has  $l = 2$
  - (ii) Can have  $m_l = -1$
  - (iii) Is empty in a nitrogen atom
  - (iv) Is full in a carbon atom
  - (v) Contains the outermost electrons in a beryllium atom
  - (vi) Can contain two electrons, both with spin  $m_s = +\frac{1}{2}$
- e. Why do atomic radii increase going down a group of the periodic table? [1 mark]
- f. Order the following atoms according to increasing atomic radius: S, F, O. [1 mark]
- g.  $P_4O_{10}$  forms oxoacid when it dissolves in water. Show the reaction involved by writing a balanced equation. [1 mark]

### Question 3 [10 marks]

- a. Draw Lewis structure for the following molecules.
- (i)  $PCl_3$  [1 mark]
  - (ii)  $SOCl_2$  [1 mark]
- b. The proton numbers of X, Y and Z are 12, 7 and 17 respectively.
- (i) Write the electronic configuration of X and Z. [1 mark]
  - (ii) Give the formula of the compounds formed between
    - (1) X and Z [½ mark]
    - (2) X and Y [½ mark]
- c. Water molecules can form intermolecular hydrogen bonding. Explain what is hydrogen bonding and how it affects the boiling point of water. [2 marks]
- d. Graphite and diamond are two allotropes of carbon. Graphite is a conductor while diamond is a non-conductor. Explain their difference in terms of structure and bonding. [2 marks]
- e. Name the intermolecular forces operating between the particles of the following liquids:
- (i) Trichloromethane [½ mark]
  - (ii) Ethanol [½ mark]
  - (iii) Aluminium fluoride [½ mark]
- Arrange the above compounds in the order of increasing boiling points. [½ mark]

Continued.....

**Question 4 [10 marks]**

- a. According to the collision theory of reaction rates, state two main requirements that must be met before an elementary reaction between two molecules can occur.

[2 × ½ mark]

- b. For each of the following terms/concepts, give a brief explanation or definition.

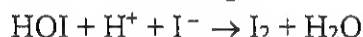
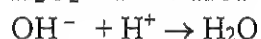
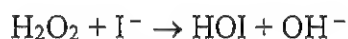
(i) order of a reaction

[1 mark]

(ii) reaction intermediate

[1 mark]

- c. The rate law for the reaction  $\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{H}_2\text{O}$  is  $\text{rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$ . The following mechanism has been suggested.



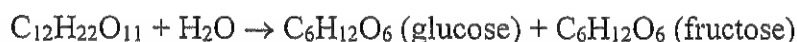
(i) Determine the overall order of this reaction.

[1 mark]

(ii) Identify all the intermediates in this mechanism.

[2 × ½ mark]

- d. Sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , reacts slowly with water in the presence of an acid to form two other sugars, glucose and fructose, both of which have the same molecular formulas, but different structures.



The reaction is first order and has a rate constant of  $6.2 \times 10^{-5}/\text{s}$  at  $35^\circ\text{C}$  when the  $\text{H}^+$  concentration is 0.10 M. Suppose that the initial concentration of sucrose in the solution is 0.40 M.

[2 × 1½ mark]

(i) What will the sucrose concentration be after 2.0 hours?

(ii) How many minutes will it take for the sucrose concentration to drop to 0.30 M?

- e. Given the equation for the photosynthesis reaction:



How would the equilibrium change if the following changes in reaction conditions were made? Briefly explain why.

[2 × 1 mark]

(i) increase the number of moles for  $\text{CO}_2$

(ii) decrease the temperature

Continued.....

**Question 5 [10 marks]**

- a. 1.25 M solution of a weak acid (HA) is 9.2% dissociated. What is the pH of the solution? [2 marks]
- b. (i) Define an acid according to the Arrhenius theory, and write a balanced equation (use HCl as the acid) to support this definition. [1 mark]
- (ii) Define a base according to the Brønsted-Lowry theory, and write a balanced equation (use CH<sub>3</sub>NH<sub>2</sub> as the base) to support this definition. [1 mark]
- c. Determine the pH of a KOH solution made by mixing 0.251 g KOH with enough water to make  $1.00 \times 10^2$  mL of solution.  
[Atomic mass : K = 39.1; O = 16.0; H = 1.0] [3 marks]
- d. Aqueous solutions of different acids, with the same concentration, have different pH values.

Acid	Concentration	pH value
Hydrochloric acid	0.10 mol dm <sup>-3</sup>	1.0
Ethanoic acid	0.10 mol dm <sup>-3</sup>	3.0

- (i) What do you understand by the term 'pH value'? [½ mark]
- (ii) How is the pH value related to the concentration of hydrogen ions? [½ mark]
- (iii) Explain the difference in the pH values of the two acids. [2 marks]

**End of Paper**